Active Project (2016 - 2016)

Color-XHDR - A Compact High-Speed Color Extreme High Dynamic Range Video Capability for Rocket Engine Testing, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Innovative Imaging and Research (I2R) proposes to develop a 21st Century high-speed, color extreme high dynamic range (Color-XHDR) video recording system that will produce calibrated, engineering-grade video to accurately document rocket motor firings, at close range within a test cell, without image saturation. This novel imaging system will include a compact, single camera/single focal plane array camera and end-to-end image processing software to produce, high quality, low noise, high-speed video not currently possible with today's technology. The compact cameras will be compatible with existing SSC camera housing, as all acquired imagery will be stored off-camera to prevent loss of information in the event of a mishap. The system will be able to record entire test sequences at 250 fps lasting up to 45 minutes. Most importantly, the system will produce XHDR (>120 dB dynamic range) HD format imagery so that relatively dark test cell infrastructure and test article hardware will be visible alongside exhaust plumes that may also contain hot molten debris with brightness levels approaching that of the sun. Because the imagery will be calibrated, the system will also provide engineering information such as color temperature and particle trajectory velocities. Geometric calibration will enable multiple properly positioned cameras to provide accurate 3-D XHDR image products. Rocket engine certification ground testing requires clear visual high-speed video recording that can capture essential information for NASA during rocket engine certification ground testing. This need is particularly true in the event of a mishap, when investigations into the underlying cause ensue. The cameras in use today at SSC have significant limitations including plume saturation, rolling shutter image wobble, camera geometric distortion, and no off-board storage, which makes it nearly impossible, in catastrophic situations that result in the loss of a camera, to obtain critical information.

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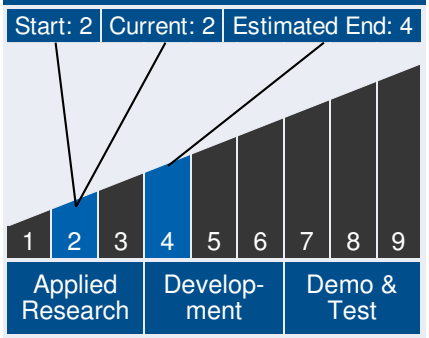
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Continued on following page.

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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Compact, color, high-speed, extreme high dynamic range (Color-XHDR) video recording that can produce calibrated, engineering-grade video to accurately record high energy events, such as rocket motor firings, at close range, without image saturation will have significant value to NASA SSC. After a successful Phase II, I2R will be in a position to provide their state-of-the-art system to NASA SSC for incorporation directly onto the test stands. In addition to the facility at SSC, other NASA Rocket Propulsion Test (RPT) and NASA launch facilities namely Kennedy Space Center (KSC), Marshall Space Flight Center (MSFC), Glenn Research Center (GRC) Plum Brook Station and White Sands Test Facility (WSTF) will benefit by using this technology. This technology can also be incorporated into other NASA missions including both terrestrial and planetary exploration. Since, for example, there is relatively no atmosphere on Mars, there is limited diffuse scattering and dark shadows become visually darker. This effect increases the dynamic range of the scene making it an ideal target application for our technology. Similarly, our technology could be used to uncover the mysteries surrounding the extremely bright saturated spots captured by NASA?s Dawn mission on the dwarf planet Ceres.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Compact, color, high-speed, extreme high dynamic range (Color-XHDR) video recordings that can produce calibrated, engineering-grade information to accurately record high energy events, such as rocket motor firings, at close range, without image saturation will have significant value to defense-based facilities that actively test propulsion systems and perform launches. These include the USAF Arnold Engineering Development Center (AEDC) and the Air Force Research Laboratory at Edwards Air Force Base

Management Team *(cont.)*

Program Manager:
- Carlos Torrez

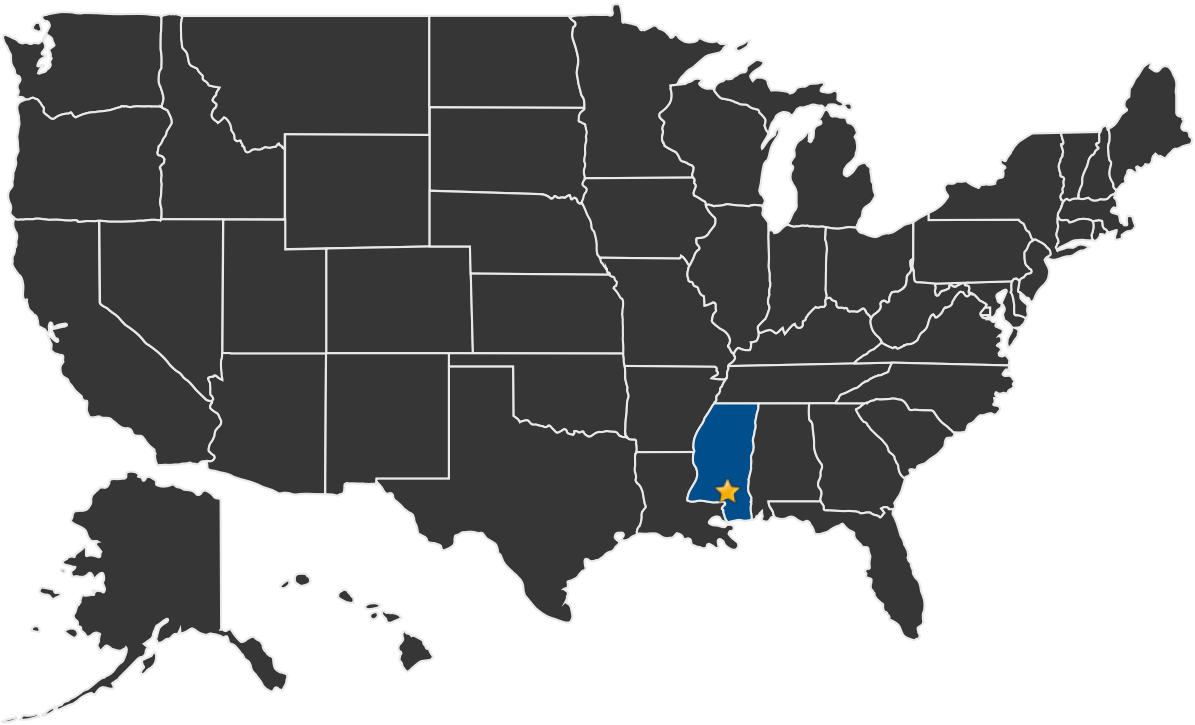
Principal Investigator:
- Robert Ryan

Technology Areas

Primary Technology Area:
Ground and Launch Systems (TA 13)
- Operational Life-Cycle (TA 13.1)
  - Logistics (TA 13.1.4)

as well as Vandenberg Air Force Base. Commercial propulsion test and development entities, such as Orbital ATK, SpaceX and Blue Origin, would also benefit by our technology. In addition to rocket propulsion, other application areas that would benefit from our imaging technology including robotic welding and 3-D metal printing where bright-dark contrast become extreme. Another potential application is small area UAV remote sensing and mobile mapping. Our compact technology approach will enable our imaging systems to be flown on small UAVs. We have spoken to imaging and mapping companies developing technology for strip mining where deep shadows produce extreme contrast. Routinely mapping mining areas is important for managing a site and to maintain safety. Mobile mapping from moving ground vehicles is limited by the dark shadows produced in many landscapes. Compact HDR imaging could increase the utility of the images taken by these systems.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Stennis Space Center

Other Organizations Performing Work:

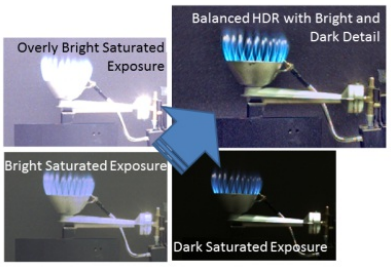
- Innovative Imaging and Research Corporation (Stennis Space Center, MS)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23177)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

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